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(54) MATERIAL FOR PERMANENT MAGNET AND PERMANENT MAGNET

(57)Abstract:

PURPOSE: To obtain a permanent magnet having good characteristics by using an R-T-B compound (where, T represents Fe and/or Co) for the magnet so that the magnet can have the main phase of a tetragonal compound or so that the magnet can have the main phase and an amorphous and/or crystalline auxiliary phase and magnetic susceptibility equal to or lower than a specific value in an external magnetic field having a specific intensity.

CONSTITUTION: This material is a powdery material containing R (one or more kinds of rare-earth element including Y), Fe or Fe and Co, and B and has ≥ 0.5 magnetic susceptibility $X'(4\pi I/H)$ when the intensity H of the external magnetic field is 800Oe and 90-600 μ m particle size.

The title permanent magnet can be formed to a bonded magnet by dispersing the material in a binder or to a bulky magnet by warm-molding the material. Therefore, the material hardly condenses and can be stably supplied to metallic molds.

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Notes:

1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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CLAIMS

[Claim(s)]

[Claim 1] It is a powdered permanent magnet material containing Fe or Fe and Co, and B -- the external magnetic field hardness H -- 800 Oe it is -- permanent magnet material characterized by magnetic susceptibility χ' at the time $(4\pi I/H)$ being 0.5 or less. [R (however, R is one or more sorts of the rare earth elements containing Y.),]

[Claim 2] Grain size of 90 micrometers Permanent magnet material of Claim 1 which does not contain the grains of the following substantially.

[Claim 3] Grain size of 600 micrometers Claim 1 which does not contain the grains of ** substantially, or 2 permanent magnet materials.

[Claim 4] The permanent magnet characterized by the permanent magnet material of Claim 1 or either of 3 being the BONDIDDO magnet currently distributed in the binder.

[Claim 5] The permanent magnet characterized by being the bulk-like magnet which carried out warm working of the permanent magnet material of Claim 1 or either of 3.

DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Industrial Application] This invention is R (R is the rare earth elements containing Y.). It is below the same. It is related with the magnet using the permanent magnet material powder and this permanent magnet material powder of a Fe-(Co)-R-B system which contains Co further including Fe and B.

[0002]

[Description of the Prior Art] As a rare earth permanent magnet which has high performance, the thing of energy product 32MGOe is mass-produced with the Sm-Co system magnet by a powder metallurgy process. However, this thing has the fault that the raw material price of Sm

and Co is high. In rare earth elements, an element with a small atomic weight, for example, cerium and praseodymium, and neodymium are in Toyotomi, and its price is cheaper than samarium. Moreover, Fe is inexpensive compared with Co. Then, R-Fe-B system magnets, such as Nd-Fe-B, are developed, and what is depended on a high-speed quenching method is indicated by JP,S60-9852,A in recent years.

[0003] It is applied to bulk-like magnets, such as a powder-compacting magnet, and also the magnet manufactured by the high-speed quenching method is used as a BONDIDDO magnet with which magnet powder was combined with the binder of resin or non-magnetic metal.

Although a bulk-like magnet generally has the fault that it is hard and weak, there is neither a chip nor a crack, a BONDIDDO magnet has elasticity lightly, molding of complicated form is easy, and since it excels in mass-production nature, a use is in the tendency of expansion.

[0004] In manufacture of a BONDIDDO magnet or a bulk-like magnet, it is important for it to be stabilized and to supply magnet material powder to a metal pattern. If supply of magnet material powder becomes unstable, density dispersion of a molding body will be produced and dispersion will be produced in the characteristics of the magnet obtained. Magnetization of magnet material powder is mentioned as the main factor which bars adequate supply of the magnet material to a metal pattern. Magnet material powder may be magnetized by the manufacture spot by the carelessness at the time of, and being handling. [molding-among magnetic field equipment, a magnet, the magnetized tool, a magnetization machine, etc.]

[what generates a magnetic field] When magnet material powder is magnetized, powder condenses, when supply to a metal pattern becomes unstable and produces a thin molding body and a complicated-shaped molding body especially, powdered restoration becomes poor, and dispersion in a molding body density is produced.

[0005]

[Problem(s) to be Solved by the Invention] This invention aims at offering the magnet to which characteristics were equal, and the suitable powder magnet material for manufacture of such a magnet.

[0006]

[Means for Solving the Problem] Such a purpose is attained by this invention of following the (1) - (5).

(1) it is a powdered permanent magnet material containing Fe or Fe and Co, and B -- the external magnetic field hardness $H \sim 800$ Oe it is -- permanent magnet material characterized by magnetic susceptibility χ' at the time $(4\pi i/H)$ being 0.5 or less. [R (however, R is one or more sorts of the rare earth elements containing Y.),]

(2) Grain size of 90 micrometers Permanent magnet material of the above (1) which does not contain the grains of the following substantially.

(3) Grain size of 600 micrometers The above (1) which does not contain the grains of **

substantially, or (2) permanent magnet materials.

(4) The permanent magnet characterized by the permanent magnet material of the above (1) or either of (3) being the BONDIDDO magnet currently distributed in the binder.

(5) The permanent magnet characterized by being the bulk-like magnet which carried out warm working of the permanent magnet material of the above (1) or either of (3).

[0007]

[Function and Effect] The hardness of the magnetic field added to magnet material powder by the carelessness in the case of handling etc. at the magnet manufacture spot is usually 800 Oe. It is below a grade. The permanent magnet material of this invention is 800 Oe. Since the magnetic susceptibility which can be set is as low as 0.5 or less, it is hard to condense a magnet material in the case of molding, and adequate supply in a metal pattern is realized.

[0008]

[Elements of the Invention] The concrete composition of this invention is explained in detail hereafter.

[0009] The permanent magnet material of this invention R (however, R is one or more sorts of the rare earth elements containing Y.), It is the powdered material containing Fe or Fe and Co, and B, and it has only the main phase of the crystal structure of a tetragonal system substantially, or they are such a main phase, and amorphous and/or the thing which has the subphase of a crystalline substance. A tetragonal compound stable as a R-T-B compound (T is Fe and/or Co) is $R_2 T_{14} B$ ($R = 11.76$ atom %, $T = 82.36$ atom %, $B = 5.88$ atom %), and the main phase is substantially formed from this compound. Moreover, a subphase exists as a crystal grain boundary of the main phase.

[0010] the permanent magnet material of this invention -- the external magnetic field hardness H -- 800 Oe it is -- magnetic susceptibility χ' at the time is 0.3 or less more preferably 0.4 or less 0.5 or less. It is $\chi' = 4\pi I / H$, and I is magnetization in case external magnetic field hardness is H , and is the value measured about the whole powder. If χ' has exceeded said range, it will become easy to condense a magnet material and molding public-funds type adequate supply will become difficult. In addition, although the minimum in particular of χ' does not prepare, less than 0.03 magnet material of χ' is difficult to magnetize.

[0011] The permanent magnet material of this invention grinds the magnet material obtained by the high-speed quenching method, and is manufactured. Although it is desirable to use the ** rolling method and a twin-roll process for a high-speed quenching method, you may use the gas atomizing method etc. Heat treatment for the improvement in magnetic properties is usually performed to the shape of a thin band manufactured by the quenching method, a thin film integrated circuit, and the permanent magnet material of granular **.

[0012] 800 Oe Although conditions in particular for the magnetic susceptibility which can be set to obtain the magnet material which is the above-mentioned range are not limited, magnetic

susceptibility can be adjusted by controlling the conditions of heat treatment after quenching. In this case, what is necessary is just to control a heat treatment condition suitably according to a presentation, quenching conditions, etc. of a magnet material. Moreover, it is adjustable also by in addition to this controlling quenching conditions suitably. Moreover, it can adjust by various methods besides these methods.

[0013] Moreover, the method of carrying out the classification of the permanent magnet material after quenching by a screen etc., and removing fines and coarse powder is also effective in χ' reduction. In this case, grain size of 90 micrometers The following is especially a grain with a grain size of less than 150 micrometers and/or the grain size of 600 micrometers. **, especially grain size of 350 micrometers It is desirable to carry out a classification so that the grains of ** may not be contained substantially.

[0014] The permanent magnet material of this invention is applied to the bulk-like magnet manufactured by a BONDIDDO magnet or warm working. When applying to a BONDIDDO magnet, any, such as resin and non-magnetic metal, may be used for a binder, and which methods, such as press molding and injection molding, may be used for molding.

[0015]

[Example] Hereafter, the concrete example of this invention is shown and this invention is explained still in detail.

[0016] The alloy ingot which has the presentation (a numerical value expresses atomic percent) of 12Nd-6B-5Co-77Fe was produced by arc melting. The obtained alloy ingot was put into the quartz nozzle, and it was considered as the molten metal by high-frequency induction heating. This molten metal was quenched by the ** rolling method, and the flaky permanent magnet material was manufactured. Performing quenching in Ar gas atmosphere, ambient pressure power was 1 atmosphere. In addition, it is the peripheral velocity of a cooling roller 10 - 45 m/s It changed in the range and several permanent magnet materials with which cooling conditions differ were manufactured.

[0017] A pin mill grinds such material and it is the mean particle diameter of 170 micrometers. Magnet material powder was obtained. External magnetic field hardness 800 Oe of these powder Magnetic susceptibility χ' at the time was measured with the sample oscillating type magnetometer. A result is shown in the following table 1.

[0018] It is external magnetic field hardness 400 Oe about these powder. After being magnetized, 100 BONDIDDO magnets were manufactured about each powder, respectively, and mean density and density dispersion were investigated. Standard deviation estimated density dispersion. A result is shown in Table 1.

[0019] In addition, the BONDIDDO magnet was produced by the following method. First, the magnet material powder magnetized to the organic solvent which dissolved the epoxy resin was thrown in and agitated, and it was considered as slurry. This slurry was dried and resin

covering was formed in the magnet material grain surface. Subsequently, the metal pattern was filled up with powder and press molding was performed. The metal pattern which has ring-like molding space with the outside diameter of 10mm, an inside diameter of 9mm, and a thickness of 7mm was used for press molding.

[0020]

[Table 1]

磁石材料 粉末No.	χ'	密度標準偏差 (g/cm ³)	平均密度 (g/cm ³)
1	0.07	0.006	6.15
2	0.18	0.009	6.17
3	0.32	0.013	6.14
4 (比較)	0.55	0.025	6.10
5 (比較)	0.85	0.032	6.08

[0021] The effect of this invention is clear from the result shown in Table 1. In addition, the same result was obtained, also when each above-mentioned powder was molded by warm working and it was considered as a bulk-like magnet. Moreover, a screen is used for each above-mentioned powder, and it is the grain size of 150 micrometers. The grains and grain size of 600 micrometers of the following When the classification was carried out so that the grains of ** might not be contained substantially, χ' decreased and density dispersion after molding decreased further.

[Translation done.]